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M E M O R A N D U M
November 27, 1979

To: Phil Williams

From: Bill Yake and Greg Cloud

Subject: The Effects of Waitsburg Wastewater Treatment Plant Effluent on Coppei Creek

Introduction

The town of Waitsburg has applied, through the Department of Ecology (DOE), for grant funds to upgrade their sewage treatment plant. Because grant requests exceed grant funds, project applications are prioritized. Priority rating is based on a number of factors, including an assessment of the effluent impact on water quality. In Waitsburg's case, few water quality data were available and stream degradation could only be estimated.

Setting

Waitsburg is a small town (population 1,075) located at the confluence of Coppei Creek and the Touchet River. The town is served by an old trickling filter plant which discharges to Coppei Creek about 0.4 mile above its mouth (see Figure 1).

The drainages of both streams are devoted primarily to dry-land agriculture. This receiving water segment (Touchet River and tributaries, 15-32-03) is Class A and identified in the 5-Year Strategy as not meeting Class A (fishable and swimmable) standards for fecal coliforms and turbidity, based on ambient water quality collected at the Touchet River at Touchet (32B070) and Touchet River at Bolles (32B100) stations. The median fecal coliform concentrations at Bolles were 100 organisms/100 ml with a maximum of 1200 organisms/100 ml. As noted in the results section of this memorandum, the Waitsburg STP may bear a substantial portion of the responsibility of the non-compliance of this station with fecal coliform standards.

Waitsburg is located at the western edge of the Palouse hills and both streams can carry heavy silt loads during high runoff periods. There are no major point discharges upstream of Waitsburg in either drainage. The streams differ markedly in physical character. The Touchet is a swift, shallow stream with a mean annual flow of 233 cfs at river mile 40.1 about 2 miles downstream from Waitsburg (USGS, 1978). Coppei Creek is a small stream which slows as it reaches the flood plain of the Touchet. It meanders south and west of Waitsburg through a series of runs and pools. The pools are three to four feet deep even during low flow.

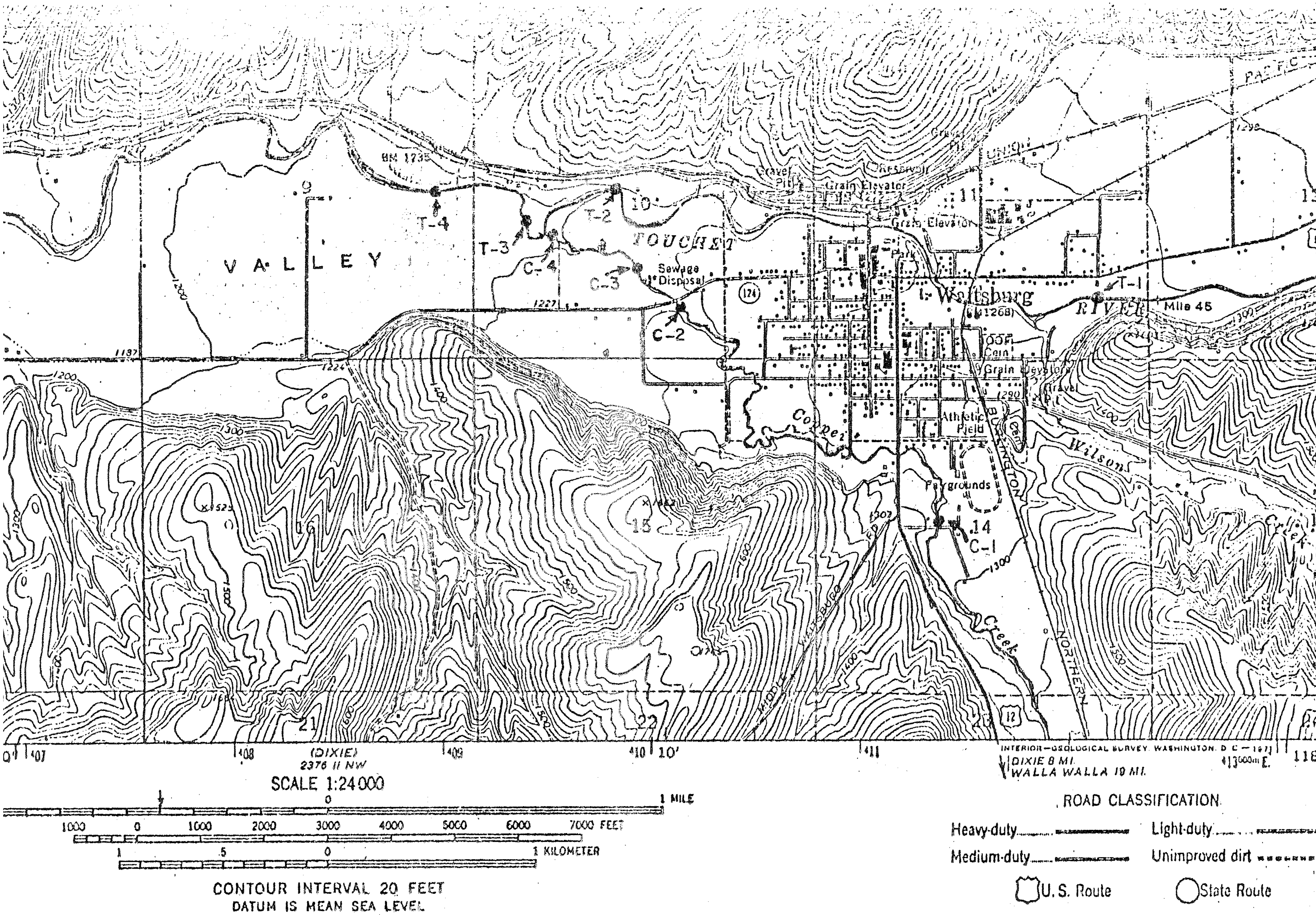

FIGURE 1 Study Area

Coppei Creek is used for both recreation and irrigation. The Washington State Department of Game (WDG) stocks Coppei Creek with legal-sized rainbow trout. The creek is said to be a popular fishery with local residents (particularly children). The stream is most accessible to fishing upstream or from the sewage treatment plant. There are numerous small withdrawals along the lower creek and at least two withdrawals which can run the creek dry when low flow coincides with the irrigation season.

The Touchet River has uses similar to those of Coppei Creek. Upstream from Waitsburg there is a brown trout fishery which is supported by WDG. WDG also indicated that steelhead run to the North Fork of the Touchet. Local residents indicate that steelhead originally ran in the Touchet River past Waitsburg but that this run has declined drastically over the past 10 to 20 years.

Except for the areas affected by the treatment plant effluent, the streams visually appear to be in good condition. Most of the natural streamside vegetation remains intact, buffering the streams from much of the impact of agriculture and streambank erosion.

The Waitsburg sewage treatment plant is described in some detail in the accompanying Class II inspection memorandum (Yake, 1979). In short, the trickling filter plant has several design deficiencies. Design peculiarities and deficiencies include the use of a single clarifier which serves both primary and secondary functions, an influent wet well/pumping system which is responsible for surging flows through the treatment units, and a chlorine contact chamber which cannot be easily cleaned without flushing settled solids to Coppei Creek.

Methods

Water samples and benthic invertebrate samples were collected at 8 stream stations. Four of these stations were located on Coppei Creek and four on the Touchet River (Figure 1). Stations were located to allow detection of changes in water quality as the streams passed through Waitsburg and to focus particularly on the affect of the plant effluent. The river mile location of stations is listed in Table 1.

Table 1. Location of Stream Stations

Designation	Description	River Mile
C-1	Coppei Creek above Waitsburg	2.05
C-2	Coppei Creek above STP	0.55
C-3	Coppei Creek below STP	0.42
C-4	Coppei Creek at Mouth	0.36
T-1	Touchet River above Waitsburg	44.78
T-2	Touchet River above Coppei Creek	43.25
T-3	Touchet River 0.1 mile below Coppei Creek	42.91
T-4	Touchet River 0.4 mile below Coppei Creek	42.62

Field measurements and water samples were taken on both September 10 and 11, 1979. A single invertebrate collection was made at each station.

With the exception of fecal coliform samples, all treatment plant samples were obtained from a 24-hour time composite sampler. This composite sample was obtained during the same time period.

Field measurements obtained at each station were temperature (°C), pH, dissolved oxygen (Winkler-Azide modification), and specific conductivity.

Flow was determined using a magnetic flow meter with top-setting rod. A velocity profile and depth measurements were used to calculate flow.

Water samples were taken concurrently, packed in ice, and transported to the DOE Tumwater laboratory for the following analyses:

1. Chemical Oxygen Demand
2. Biochemical Oxygen Demand
3. Solids (TS, TVS, SS, VSS)
4. Turbidity
5. Ortho-phosphate-P
6. Total phosphate-P
7. Ammonia-Nitrogen
8. Nitrite-Nitrogen
9. Nitrate-Nitrogen
10. Organic Nitrogen

Un-ionized ammonia was calculated from ammonia-nitrogen, pH, and temperature data (EPA, 1976).

Biological samples were taken at all stations to assess changes in the populations of benthic (bottom dwelling) invertebrates. These organisms (primarily immature insects) move little. Thus, invertebrate community structure provides a good measure of the long-term effects of pollution. For this effort, three stones of approximately equal size and shape (oval and about 5 to 6 inches in diameter) were collected from riffles near each station. Each stone was placed in a small-meshed net, washed and rinsed until all visible organisms were removed. These organisms were preserved in 70% alcohol. Later, organisms were keyed to the most specific taxonomic level readily attainable and the Shannon (Lloyd, *et al.*, 1968) and Brillouin (Archibald, 1972) diversity indices were computed for each station.

Results and Discussion

At the time of the survey, the Touchet River flow was near the minimum level for the year. Flows measured during the survey ranged from 31.3 to 32.4 cfs. Flows obtained by the USGS at their Touchet River at Bolles, Washington station (14017000) on September 11 and 12 were 32 and 31 cfs, respectively. By way of comparison, the low flow during water year 1978 was 33 cfs.

Although there is little published flow data on Coppei Creek, it is likely that its flow (1.3 to 1.7 cfs) was similarly near the minimum expected level. Local residents indicate, however, that irrigation withdrawals in the lower Coppei can dry up the creek entirely. A check with Water Resources at the Eastern Regional Office revealed two major withdrawals from the lower Coppei. These are listed in Table 2.

Table 2. Major Permitted Irrigation Withdrawals in Lower Coppei Creek

Certificate Number	Permitted Withdrawal	Approximate River Mile	Acreage	Permitted Withdrawal Period
10735	0.2 cfs	0.5	10 acres	Oct. 1 to Apr. 1
10709	1.11 cfs	1.5	140 acres.	Oct. 1 to July 1

Although the permitted withdrawal period would appear to preclude withdrawals at low flow, a check with the water master (Harold Hanson) revealed that these conditions are not commonly enforced unless complaints are received from downstream water rights holders. The two withdrawals are specified for irrigation use. It is therefore likely that withdrawal proceeds during the low flow/irrigation period from June through August.

Thus, the results of this survey best reflect low flow conditions, although in the case of Coppei Creek, conditions in lower Coppei Creek may be substantially worse when irrigation withdrawals severely reduce flows or dry up the creek above the treatment plant.

The results of physical and chemical analyses are tabulated in Table 3; the results of invertebrate sampling in Table 4. In a general sense, the physio-chemical and biological character of both streams upstream of Waitsburg is remarkably similar and indicative of good quality waters.

As the stream passes near and through Waitsburg, there is some water quality degradation prior to the sewage plant discharge. Conductivity, dissolved solids, nitrate-nitrogen, and organic-nitrogen concentrations increase in both streams. In addition, fecal coliform counts increase dramatically in Coppei Creek from approximately 70 to 550 organisms per 100 mls (well above Class A standards). In terms of loading, the nitrate increase in the Touchet River is particularly notable because it represents an increase of about 30 lbs of NO_3-N/day. This compares to a total nitrogen loading from the treatment plant of 29 lbs N/day. Increases in nitrate-nitrogen, from sources other than the sewage treatment plant, approximately doubled concentrations in both receiving waters, elevating them above the algal bloom potential level (0.3 mg NO_3-N/l) established by Klein (1959). Orthophosphate and total phosphate concentrations exceeded bloom potential levels (0.01 and 0.05 mg P/l respectively) at all stations.

Table 3. Results, Physical and Chemical Analyses

Parameter	Coppei Creek C-1	C-2	C-3	C-4	Touchet River T-1	T-2	T-3	T-4	Waitsburg STP
Flow (cfs)	1.29	1.61	(1.80)	1.67	32.2	32.4	(34.1)	31.3	0.19
Dissolved Oxygen (mg/l)	11.0 10.6	9.8 10.6	9.2 8.1	5.7 6.1	11.3 10.9	11.2 11.2	11.0 11.0	11.4 11.5	3.6
O_2 Saturation (%)	113% 105%	100% 105%	96% 83%	57% 60%	113% 109%	113% 113%	112% 112%	115% 118%	41%
COD (mg/l)	10 6	12 4	31 31	23 12	8 8	6 10	12 8	8 10	123*
BOD_5 (mg/l)	2	<2	6	9	2	2	2	<2	45*
Ammonia-N (mg/l)	.05 .03	.09 .11	1.1 1.5	.39 .40	.02 .06	.01 .01	.02 .08	.05 .03	11.2*
Un-ionized Ammonia-N (mg/l)	.003 .002	.001 .001	.018 .018	.001 .006	<.001 .003	<.001 <.001	.001 .005	.002 .002	.193*
Nitrite-N (mg/l)	<.01 <.01	<.01 <.01	.11 .12	.10 .10	<.01 <.01	<.01 <.01	<.01 <.01	<.01 <.01	0.6*
Nitrate-N (mg/l)	.08 .14	.33 .33	.42 .46	.73 .77	.17 .14	.34 .33	.35 .35	.38 .33	<0.2*
Organic Nitrogen-N (mg/l)	.15 .19	.34 .39	.69 .62	.40 .54	.10 .12	.13 .19	.06 .12	.29 .22	16.3*
Total Nitrogen-N (mg/l)	.28 .36	.76 .83	2.3 2.7	1.6 1.8	.33 .32	.48 .53	.43 .55	.72 .58	28.1*
Orthophosphate-P (mg/l)	.07 .07	.10 .08	.65 .80	.54 .53	.09 .06	.06 .05	.08 .09	.08 .08	6.4*
Total Phosphate-P (mg/l)	.08 .08	.07 .10	.70 .85	.54 .47	.10 .09	.07 .09	.10 .10	.08 .09	8.4*
Specific Conductivity (µmhos/cm)	131 109	155 162	242 235	252 198	125 120	142 148	138 138	155 148	1,010 650
pH (Standard Units)	8.4 8.3	7.9 7.7	7.7 7.6	7.1 7.7	8.0 8.3	8.5 8.4	8.4 8.4	8.2 8.5	7.6*
Temperature (°C)	14.7 12.9	14.4 13.3	15.5 14.8	13.6 13.0	13.5 13.7	14.1 14.0	14.6 14.3	14.0 14.8	20.2 20.4
Fecal Coliform (No./100 ml)	84 58	510 570**	19,000** 1,600**	1,200 370**	14** 4**	10** 1**	62 60**	76 50	>6,000 25,000
Volatile Sus. Solids (mg/l)	5 2	4 1	5 6	4 2	4 0	3 0	1 0	2 0	22*
Total Suspended Solids (mg/l)	8 4	10 3	14 10	10 6	6 1	6 1	4 1	6 2	22*
Total Vol. Diss. Solids (mg/l)	15 23	16 31	32 48	14 53	35 24	35 47	34 63	51 28	130*
Total Diss. Solids (mg/l)	110 130	120 140	160 180	170 170	110 100	130 130	120 150	130 120	540*
Total Solids (mg/l)	120 130	130 150	180 190	180 180	120 100	130 130	120 150	140 120	560*
Turbidity (JTU's)	4 4	6 5	9 8	6 5	3 2	2 2	3 2	3 3	50*

* Analysis of composite sample.
** Estimated (non-ideal) counts.
( ) Calculated flow.
"<" is "less than" and ">" is "more than"

There was little indication of nuisance algae blooms at the time of the survey. However, the Touchet River has numerous macrophyte (rooted aquatic plant) patches and increased nutrient loading probably accelerates the growth of these plants.

The effect of the treatment plant effluent on Coppei Creek is substantial. Concentrations of all nitrogen forms, phosphate forms, and solids fractions increase. Chemical oxygen demand, biochemical oxygen demand, and conductivity also increase. Turbidity increases marginally. Fecal coliform counts increased from about 550 to 1,600 and 19,000/100 mls. Dissolved oxygen concentrations fall and clean water invertebrates disappear, lowering species diversity substantially.

These physical, chemical, and biological changes are inter-related and provide a classic illustration of the effects of a poor-quality municipal wastewater discharge to a small stream with limited assimilative capacity. These effects will be discussed under four general headings: Dissolved Oxygen; Bacteria; Toxics; and Aquatic Biology.

Dissolved Oxygen

The decrease in dissolved oxygen concentration and percent saturation is a response to the low dissolved oxygen content of the wastewater, and biological decomposition of organic matter and ammonia discharged to the stream. The mechanisms for this dissolved oxygen sag are several and can be inferred, in part, from Figure 2.

1. The low (3.6 mg O_2/l) oxygen concentration in the discharge should theoretically result in a drop of 0.7 mg O_2/l in Coppei Creek. The average decrease measured between stations C-2 and C-3 was 1.55 mg O_2/l. The discrepancy is probably due to the fact that the stream's oxygen concentration was not measured immediately below the outfall where dilution would be the primary factor in an observed O_2 reduction. Stream accessibility required station C-3 be located approximately 150 feet downstream. The oxygen concentration observed, therefore, was the combined effect of dilution with the discharge concentration and the beginning of biochemical oxidation (described below).

2. The oxidation of ammonia contributes considerably to the oxygen decrease. Figure 2 illustrates the step increase in ammonia contributed by the discharge followed by an oxidative conversion to nitrate. This biological process is often dominant in slow, shallow, warm streams. Using the data obtained during this survey, nitrification of ammonia is responsible for an exerted oxygen demand of about 4.6 mg O_2/l. The dissolved oxygen drop between stations C-3 and C-4 averaged 2.75 mg O_2/l.

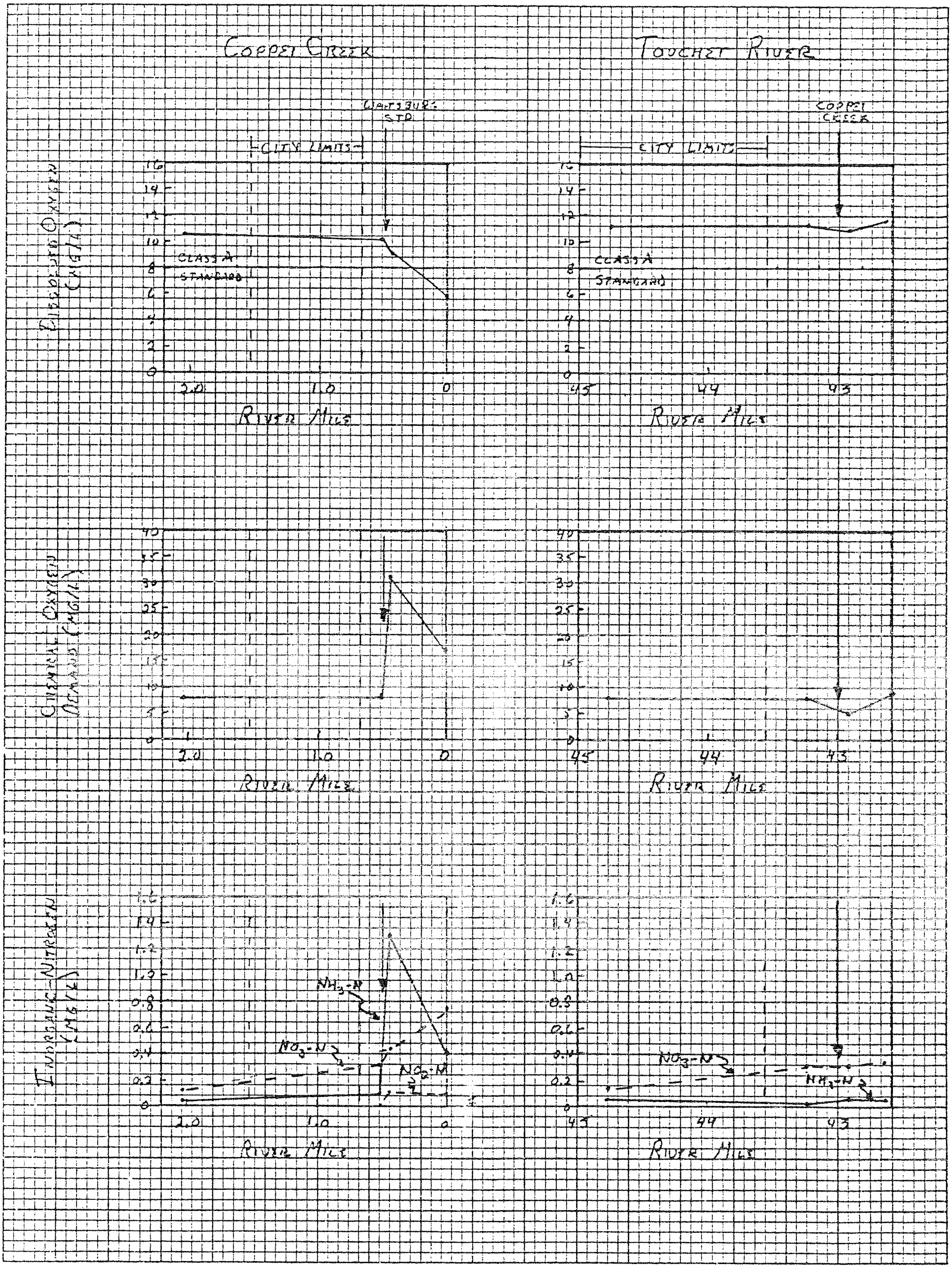

Figure 2. Phenomena Related to Dissolved Oxygen in Receiving Waters

3. Oxygen demand was exerted by other constituents (probably primarily organics) in the discharge. The average chemical oxygen demand (COD) increase measured between stations C-2 and C-3 was about 24 mg COD/l. The demand exerted by COD between stations C-3 and C-4 averaged 13.5 mg O_2/l. Ammonia conversion, as noted, would account for 4.6 mg O_2/l of this demand, leaving about 9 mg O_2/l due to other constituents.

4. An additional source of oxygen demand may be organic solids which settle to the bottom of pools in the lower Coppei and exert a demand. These solids probably consist of both those discharged during normal plant operation (an average of about 25 lbs/day of volatile suspended solids disappeared between stations C-3 and C-4) and solids discharged in a slug when the contact chamber is flushed.

The full impact of the oxygen demand exerted in the lower Coppei is not realized because of reaeration. Dissolved oxygen concentrations were not measured between stations. It is possible that lower dissolved oxygen concentrations exist between stations C-3 and C-4. Clearly, if flow in Coppei Creek is decreased by withdrawals upstream, the impact of the discharge on dissolved oxygen concentrations would be greater.

Bacteria

Concentrations of fecal coliforms in Coppei Creek were increased substantially by the discharge. Both Coppei Creek and the Touchet River are Class A waters. Criteria for Class A waters require median fecal coliform concentrations of less than 100 organisms per 100 mls with no more than 10 percent of samples exceeding 200/100 mls. By contrast, counts at C-3 were 1,600 and 19,000/100 mls. Some attenuation was noted between C-3 and C-4 with values falling to 370 and 1,200/100 mls.

Toxics

Two constituents of Waitsburg STP effluent have toxic potential. The first is chlorine. As noted in the Class II report, total chlorine residuals are kept deliberately low (0 to 0.2 mg total chlorine residual/l during the study) to prevent in-stream toxicity. Low streamflow and inadequate plant design aggravate the problem, making concurrent disinfection and low chlorine residuals impossible. Because effluent chlorine residuals were low, no attempt was made to measure them in the stream. Even with improved design, it is unlikely that plant discharge to Coppei Creek could meet both effluent standards for fecal coliform and in-stream criteria for total chlorine residual (0.002 mg/l) without dechlorination.

The second potential toxicant is un-ionized ammonia. The in-stream criteria level for un-ionized ammonia-nitrogen is 0.017 mg/l (EPA, 1976). Levels of 0.018 mg/l were calculated from data collected at C-3. Although this concentration exceeds the criteria only marginally, un-ionized ammonia concentrations are sensitive to pH, temperature, and dilution. The concurrent occurrence of high in-stream pH and temperature, coupled with a lower streamflow, could result in values well above the criteria level.

Aquatic Biology

Benthic (bottom dwelling) invertebrates are excellent indicators of water quality. These organisms spend their aquatic lives in a restricted area. While water sampling may fail to measure certain constituents or miss the intermittent presence of certain pollutants, the effects of these factors can be read in the makeup of a benthic community through the presence or absence of certain indicator species and the overall species diversity and density of the existing community. These invertebrate populations serve as the food base for stream fish populations. Species diversity is a measure of the range and balance of the types of organisms in a community. Healthy, natural populations usually have balanced communities with many types of organisms with relatively similar numerical populations. Communities which are stressed by pollution have communities dominated by a few pollution-tolerant species. Table 4 summarizes the types and numbers of organisms collected at each station and reports the calculated diversity indices. For the purpose of this report, Table 4 gives the comparative water quality associated with approximate diversity ranges. The stations falling into each range are also listed.

Table 4 - Species Diversity and Water Quality

Range of Diversities	Water Quality	Stations in this Range
0 - 0.5	Very Poor	C-3
0.5 - 1.0	Poor	---
1.0 - 1.5	Marginal	C-4
1.5 - 2.0	Fair	---
2.0 - 2.5	Good	T-1, T-2, T-3
>2.5	Excellent	C-1, C-2, T-4

It is apparent that the overall biological quality of Coppei Creek above the treatment plant is excellent and that the diversity of the benthic communities at all Touchet River stations is quite acceptable. The effect of the effluent on these communities is marked and apparent in Tables 4 and 5. Diversity drops sharply and all clean water forms are virtually eliminated, including the insect orders *Ephemeroptera* (mayfly

Table 5. [illegible]

Taxonomy	C-1 RM. 2.05	C-2 RM. 0.55	C-3 RM. 0.36	C-4 @ Mouth of Coppei Creek	T-1 RM. 44.78	T-2 RM. 43.25	T-3 RM. 42.91	T-4 RM. 42.62
	Coppei Creek				Touchet River			
Insecta								
Ephemeroptera (may flies)								
Heptageniidae								
Ironodes sp.	1	--	--	---	---	---	---	---
Rithrogena sp.	1	--	--	---	6	7	9	30
Epeorus longimanus	--	--	--	---	---	4	2	---
Unidentified genus	--	--	--	---	---	---	---	2
Baetidae								
Baetis sp.	24	25	1	---	73	7	56	26
Pseudocloeon sp.	--	--	--	---	8	12	60	189
Ephemerella bicolor	--	--	--	---	7	2	---	14
Paraleptophlebia zayante	1	--	--	---	2	---	---	---
Odonata (dragon flies)								
Coenagrionidae								
Unidentified genus	2	1	--	---	---	---	---	---
Plecoptera (stoneflies)								
Chloroperlidae								
Unidentified genus	--	--	--	---	5	4	1	1
Acroneuria								
Unidentified genus	--	--	--	---	---	---	---	3
Hemiptera (true bugs)								
Corixidae								
Unidentified genus	--	--	--	---	---	---	1	---
Tricoptera (caddisflies)								
Hydropsychidae								
Hydropsyche sp.	23	19	--	---	154	156	336	269
Unidentified genus A	--	--	--	---	---	1	16	---
Unidentified genus B	--	--	--	---	---	---	1	---
Lymnephilidae								
Unidentified genus	8	2	--	---	---	---	---	---
Helicopsychidae								
Helicopsyche sp.	15	2	--	---	---	---	---	---

Table 5. Macroinvertebrate Counts - Continued

Taxonomy	Coppei Creek C-1 RM. 2.05	C-2 RM. 0.55	C-3 RM. 0.36	C-4 @ Mouth of Coppei Creek	Touchet River T-1 RM. 44.78	T-2 RM. 43.25	T-3 RM. 42.91	T-4 RM. 42.62
Lepidoptera (aquatic caterpillars)								
Paragyractis sp.?	30	28	1	---	14	104	64	70
Coleoptera (true beetles)								
Gyrinidae								
Gyrininae sp. (larval)	--	--	--	---	---	---	---	1
Elmidae (riffle beetles)								
Narpus sp. (larval)	--	4	--	---	6	2	1	18
Narpus sp. (adult)	--	--	--	---	3	---	---	---
Diptera (flys, midges)								
Tipulidae								
Hexatoma sp.	--	--	--	---	---	---	---	2
Tendipedidae								
Chironomus sp. (larval)	14	10	25	255	61	26	16	64
Chironomus sp. (pupal)	--	--	4	11	---	---	---	8
Calopsectra sp.	14	--	--	---	34	10	18	9
Pentaneura sp.	--	--	--	---	1	---	---	---
Simulidae (black gnats)								
Simulium argus? (larval)	--	2	--	29	---	---	12	---
S. argus (pupal)	--	--	--	---	---	---	6	---
Unidentified genus (pupal)	--	--	--	---	---	---	---	4
Unknown Phyla								
Unknown Genus A	--	--	--	---	1	---	---	---
Unknown Genus B	--	--	--	---	---	1	---	---
Mollusca (snails, clams, etc.)								
Gastropoda (snails, limpets)								
Physidae (pouch snails)								
Physia sp.	--	--	3	---	---	---	---	---
Ancylidae (limpets)								
Ferrissia sp.	11	24	--	---	---	---	---	---
Planorbidae								
Planorbis sp.	--	--	--	---	---	2*	2*	---

*Empty Shells

Table [illegible] - Continued

Taxonomy	Coppei Creek				Touchet River			
	C-1 RM. 2.05	C-2 RM. 0.55	C-3 RM. 0.36	C-4 @ Mouth of Coppei Creek	T-1 RM. 44.78	T-2 RM. 43.25	T-3 RM. 42.91	T-4 RM. 42.62
Annelida (aquatic earthworms, leeches)								
Oligochaeta (aquatic earthworms)								
Unknown Genus	--	--	21,000	163	---	---	---	---
Hirudinea (leeches)								
Unknown Genus	--	--	10	1	---	---	---	---
Crustacea								
Crayfish	--	--	--	---	---	1	---	---
Shannon Diversity Index	3.00	2.69	0.025	1.26	2.51	2.19	2.23	2.55
Brillouin Diversity Index	2.80	2.50	0.024	1.24	2.42	2.10	2.17	2.49
Number of Individuals per inch^2	0.60	0.71	161	2.84	1.31	1.01	2.91	2.59

nymphs), *Trichoptera* (caddis fly larvae), and *Lepidoptera* (aquatic caterpillars). Tolerant forms, including the *Tendipeds* (midge larvae), *Oligochaetes* (aquatic worms), and the *Hirudinea* (leechs), become dominant, replacing the desirable taxa.

Figure 3 illustrates the biological impact of the discharge on the receiving waters. As is usually the case, the decrease in species diversity below the discharge is accompanied by a substantial increase in density (numbers of organisms per area of substrate). The remarkable density at station C-3 is due to huge numbers of a very small aquatic annelid (worm). Although invertebrate density gives only a rough approximation of standing crop (invertebrate population in grams per area of substrate) which, in turn, provides only an indication of productivity, the increased density of invertebrate populations below the outfall suggests that the effluent increases the productivity of the receiving waters.

The effect of the wastewater treatment plant effluent on the Touchet River is not, in general, substantial. Little or no impact was detected with respect to dissolved oxygen, solids, conductivity, pH, biochemical or chemical oxygen demand, temperature, or biological diversity. Little impact on nutrient concentrations was noted. Table 6 presents nutrient loadings observed in the effluent and lower Coppei Creek. The observed increases in Touchet River loadings are at the right of the table.

Table 6 - The Effect of Waitsburg STP Effluent on Nutrient Loadings

Parameter	Station Loadings			Increased Loadings in the Touchet River	
	Waitsburg STP	C-3	C-4	T-2 to T-3	T-2 to T-4
Total Nitrogen (lbs/day)	28.1	24.2	15.3	7.9	21.5
Total Phosphorus (lbs/day)	8.4	7.5	4.5	4.4	0.4

Increases in nutrient loadings in the Touchet River are less than those discharged by the plant. These data suggest there were in-stream nutrient removal mechanisms operating. The total nitrogen and total phosphorus loadings at stations C-3 and C-4 support this conclusion as both values dropped substantially in this stretch of the lower Coppei. The most likely mechanism for nutrient removal is plant uptake. It should be noted that this mechanism does not permanently remove nutrients. Death and decay of macrophytes in the late fall would return these nutrients to the stream.

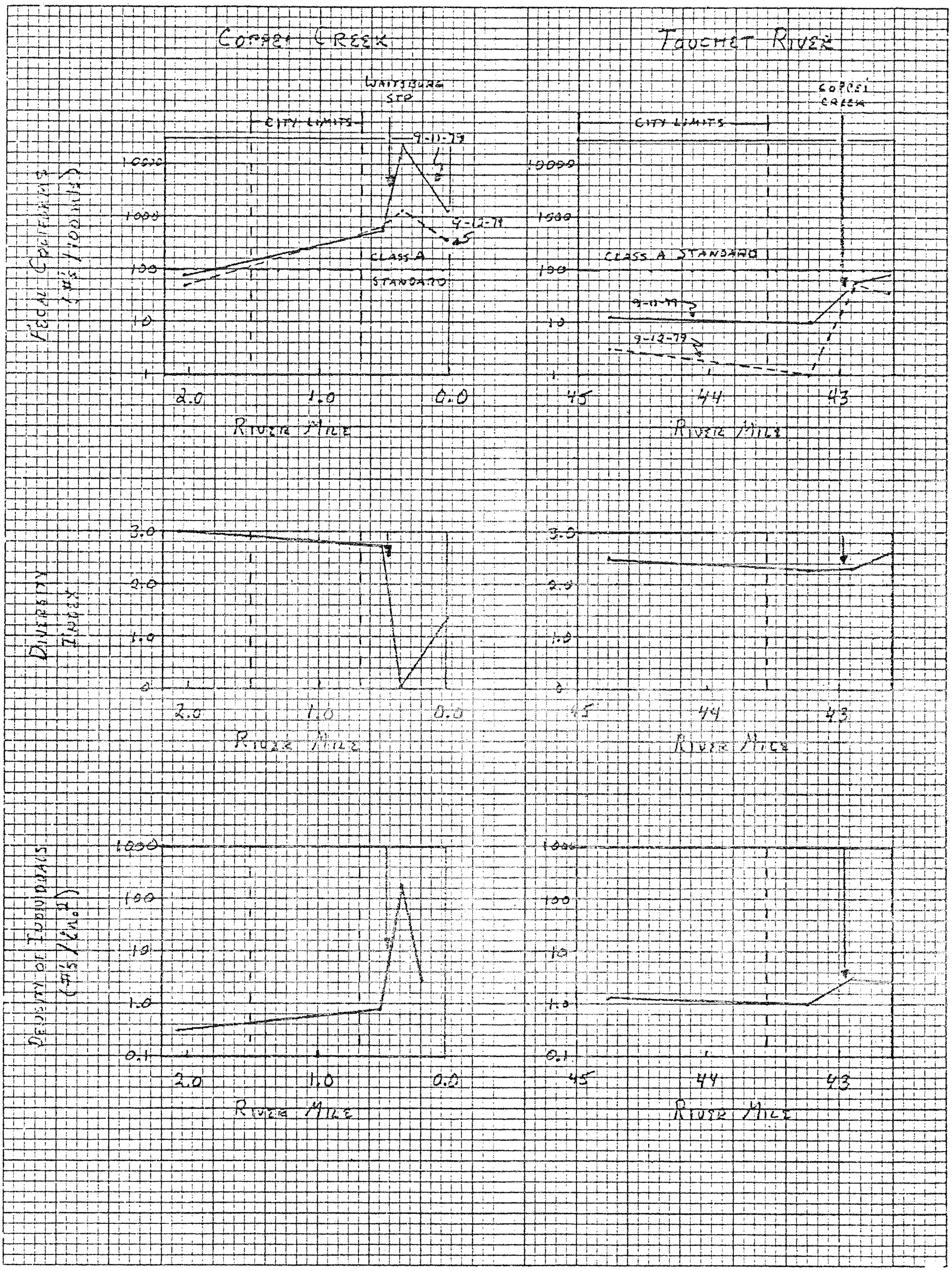

Figure 3. Biological Response of Receiving Waters

The primary discernable effect of the effluent on the Touchet was the increase in fecal coliform counts. While these increases did not result in violations of Class A water standards at the time of the survey, they did increase upstream coliform counts by 5 to 20 times and may well bear substantial responsiblity for violations of the standard detected at the Touchet River at Bolles station 2 miles downstream.

Summary and Conclusions

1. During low flow conditions, effluent from the Waitsburg wastewater treatment plant substantially degrades the water quality and beneficial uses of the final half mile of Coppei Creek. Both chemical and biological water quality measurements reflect this degradation. The effluent is responsible for violations of the Class A standards for dissolved oxygen and fecal coliform concentrations. These adverse effects are a function of both the marginal treatment efficiency of the plant (see Class II memorandum, Yake, 1979) and inadequate low flow dilution. Upstream irrigation withdrawals during low flow have the potential to aggravate this situation.

2. During this survey, the effluent appeared to be having little impact on water quality in the Touchet River. An exception to this was the finding that the effluent was responsible for increasing fecal coliform concentrations in the Touchet. There is also a significant potential for increased nutrient loading to the Touchet.

3. The impact of unidentified non-point sources in or near Waitsburg was also detected. Organic and nitrate-nitrogen, as well as fecal coliforms, increased between stations C-1 and C-2 on Coppei Creek. Increases in organic and nitrate-nitrogen also occurred in the Touchet River between stations T-1 and T-2. In the case of nitrate, this increase represented a substantial increase in loading to the river.

4. Coppei Creek has limited assimilative capacity. Even if the Waitsburg treatment plant were upgraded to meet the typical secondary treatment requirements (30/30 limitations for BOD and suspended solids), violations of fishable and swimmable receiving water criteria would probably not be eliminated in lower Coppei Creek. The potential for excess un-ionized ammonia and residual chlorine concentrations, as well as low dissolved oxygen concentrations, would remain. Addressing these concerns would probably require that the plant be designed to provide nitrification and dechlorination if continued discharge to Coppei Creek is contemplated. Receiving water quality degradation could be substancially decreased by foregoing discharge to Coppei Creek. Possible alternatives include routing the discharge to a non-overflow or seepage lagoon, land application (irrigation), discharge to a subsurface drainfield, or discharge directly to the Touchet River.

BY&GC:cp

LITERATURE CITED

Archibald, R.E.M., 1972. Diversity in some South African diatom associations and its relation to water quality, *Water Research* 6:1229-1238 pp.

Klein, L., 1959. *River Pollution I, Chemical Analysis,* Academic Press, Inc., New York

Lloyd, M, J. H. Zar, and J. R. Karr, 1968. On the calculation of information - theoretical measures of diversity, *Am. Mid. Nat.* 79(2) 257-272 pp.

USGS, 1979. *Water Resources Data for Washington. Volume 2. Eastern Washington.* Data Report WA-78-2, 236 pp.

Yake, W. E., 1979. Waitsburg Class II Inspection. Memorandum to Phil Williams, Eastern Reg. Ofc., DOE, 9 pp.

________________, 1976. *Quality Criteria for Water.* U.S. Environmental Protection Agency, 10-13 pp.